

on anthrax and on chicken cholera, the problems of immunity, virulence, and attenuation, and the crowning work on rabies.

All this we read with the avidity of a child for a twice-told tale, and the pen of Duclaux transports us back to the days when these discoveries were revolutionising the realms of medicine and surgery. Sir Rickman Godlee's "Life of Lord Lister" has reminded us afresh of the influence that Pasteur exercised on that great surgeon's work, a debt which Lister acknowledged from the inception of his own researches. Duclaux deals more briefly with the later discoveries of Pasteur, possibly because his own studies had lain more in the direction of the researches on crystallography and fermentations; this, however, is no blemish upon the book, which must always remain a classic in the history of science.

The translation has been faithfully done; at times too faithfully. Thus, on p. 7, "The general law, just now stated, that a science progresses above all by changing its point of view, explains the aid which it always derives from kindred sciences," is too literal a rendering of "La loi générale énoncée tout à l'heure, qu'une science progresse surtout en changeant ses points de vue, explique le secours qu'elle tire toujours des emprunts faits aux sciences ses voisines."

The book is well printed, and illustrated by several portraits of Pasteur at different ages and by two portraits of Duclaux. A good index has been prepared by the translators, who are also responsible for an innovation in a scientific work in respect of a "Who's Who" of persons mentioned in the book. Lister's knighthood is given, but not his peerage.

Duclaux's work thus presented should find new readers both in Great Britain and America.

A. S. M.

Applied Plant Ecology.

Plant Indicators: The Relation of Plant Communities to Process and Practice. By Frederic E. Clements. (Publication No. 290.) Pp. xvi+388+92 plates. (Washington: The Carnegie Institution of Washington, 1920.) Price 7 dollars.

DR. CLEMENTS'S enthusiastic and prolific researches in pure ecology are well known to botanists. In his latest publication he endeavours to apply his principles and methods to the practical problems of agriculture, stock-raising, and forestry, with special reference to the Western United States. According to his view, every plant is an indicator of "conditions, processes, or

uses," because it is the product of the conditions under which it grows. The individual, the species, or the community may serve as an indicator, and the choice of the unit to be employed in a given case will depend partly upon the practical end in view, and partly upon the ecological data available. To give a concrete instance: the *species Mertensia sibirica* indicates the condition "deep shade" in the montane forest of Colorado. In using plant-communities as indicators Dr. Clements relies mainly upon the dominant species, so that in practice there appears to be no sharp distinction between specific and community indicators. His general classification of types of grazing-land, however, is based upon plant-communities, inasmuch as a uniform community of grass, weed, or browse is held to indicate suitability for cattle, sheep, or goats respectively, while a prairie or a grass-scrub mictium [i.e. a mixed community containing dominants both from grass- and from scrub-associations]¹ or savannah denotes the advisability of mixed grazing by two or three kinds of animals. As an example of "individual" indicator-criteria, it is stated that ten "water-ecads" [i.e. habitat-forms corresponding to ten different degrees of water-supply] of *Ranunculus sceleratus* have been produced experimentally; plate 11 further shows photographs of [natural] shade, alpine, and "normal" ecads of *Campanula rotundifolia*, *Gentiana amarella*, and *Androsace septentrionalis*.

The nature of plant-indicators, briefly explained above, forms the principal topic of the first section (chaps. i.-iii.), which also deals with the determination and application of indicators, and includes a short historical *résumé* of the indicator concept. Chap. iv. gives a summary review of the climax [i.e. climatic] formations of western North America, and, judged by the account of Chapparal-formations—which the reviewer is best able to appreciate from personal knowledge of analogous Mediterranean formations—is adequate on the descriptive side; some useful information regarding rainfall and other environmental factors is included, and the dominant species are recorded for each formation. Altogether this chapter, already outlined in a former paper [F. E. Clements, "Plant Succession," Carnegie Institution, No. 242, 1916], is a very useful addition to the literature of plant geography.

The most interesting portion of the book is the last—roughly one-third of the whole—in which Dr. Clements discusses in detail the practical employment of indicators in the interests of farmers, stock-raisers, and foresters. A striking feature

¹ Words in square brackets are the reviewer's.

of the agricultural section (chap. v.) is the proposal to base the legal classification of land upon indicator communities. The bearing of the study of climatic cycles on agricultural practice is dealt with in the light of facts already for the most part summarised in "Plant Succession." The large amount of space devoted to grazing-indicators (chap. vi., 66 pages) is accounted for partly by the very full discussion of over-grazing, in the detection of which condition indicator-species appear to be specially helpful, and partly by a digression on the general principles of range [ranch] improvement. As regards the forestry section (chap. vii.), the very scant attention paid to afforestation is disappointing to the European reader, though comprehensible in view of the relatively large area of natural forest growth still preserved intact in North America.

In order properly to appreciate Dr. Clements's arguments, it is above all necessary to understand his point of view, which is that of a thorough-going adaptationist who regards every feature in the behaviour or structure of an organism as a response to environment. His utmost concession to the influence of heredity is the admission that "structure also possesses a well-known inertia, as the result of which it may register the impact of factors but partially or slightly." Probably few biologists will be satisfied with so meagre an allowance for the factor of inherited constitution. Further, for Dr. Clements, "ecology is the central and vital part of botany," and other lines of botanical research are, or ought to be, subordinated thereto. One need not, therefore, be surprised to meet with sweeping proposals for the radical reform of taxonomy, involving the institution of a trinomial nomenclature [!] and the virtual abolition of the use of herbarium type-specimens. Unless we are prepared to jettison the taxonomic work of the past centuries in its entirety, it is to be feared that a hasty acceptance of such revolutionary suggestions would increase rather than diminish the difficulties that already beset the taxonomist and all who depend upon him. Doubtless "the practical man is [or would like to be] concerned primarily with real species rather than with the many varieties and forms into which some of them fall"; but the problem of what are "real species" remains to be solved, and surely this desirable end is more likely to be attained through a healthy co-operation among workers in the various branches of biology than by a *tour de force* in any one of them.

Apart from such debatable matter, "Plant Indicators" is a record of a large quantity of solid

observation and experiment, and a stimulating book with a wider appeal than that of the average ecological memoir. Judgment as to the practical value of the indicator method must be suspended until it has undergone the test of extensive application under varied conditions and on an economic footing.

Dr. Clements properly lays stress on the special value of ecological research in new or partly settled regions. Oddly enough, no mention is made of those tropical countries which in every respect offer the most promising field to the ecologist, and to which American botanists have unrivalled facility of access. M. D.

The Food Problem of the United States.

The Nation's Food: A Statistical Study of a Physiological and Social Problem. By Prof. Raymond Pearl. Pp. 274. (Philadelphia and London: W. B. Saunders Co., 1920.) Price 16s. net.

ONE result of the Great War has been to bring into unusual prominence the problem of the world's food supply. Each civilised nation contains two great divisions, which in many ways are somewhat antagonistic, dependent respectively on food production and on industrial work. The problem differs in urgency for the two groups: for the food producer, living in the country, it is one of greater or smaller profits, but not of daily bread, of which he is certain; for the industrial town-dweller the problem is more serious, because the intricate social machine is easily thrown out of gear by a few disaffected spirits, and food is forthcoming only so long as the machine turns out sufficient goods to induce the production of more food than the countryman needs for his own consumption.

Prof. Raymond Pearl has given in this book a statistical study of the food problem of the United States, and with his usual thoroughness and breadth of view he has included in his inquiry so many ramifications that his investigation covers Europe also. It thus possesses extraordinary interest at the present time. His tables contain a wealth of material of which only a few indications can be given here. The contribution made by the United States to the food supply of the Allies during the war was remarkable. The pre-war average export of wheat and flour was 122.7 million bushels, of which 43.3 million went to the Western Allies; during the war, but before America's entry, it rose to 262.9 million bushels, of which 151.2 million went to the Allies; even in the first year of the war the Allies still received